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TRIP REPORT FOR A MARINE MAMMAL AERIAL SURVEY OVER THE SOUTHERN CALIFORNIA BIGHT (APRIL 13-15, 1982)

By

Charles W. Oliver

ADMINISTRATIVE REPORT LJ-91-23

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TRIP REPORT FOR A MARINE MAMMAL AERIAL SURVEY OVER THE SOUTHERN CALIFORNIA BIGHT (APRIL 13 - 15, 1982)

Charles W. Oliver

Southwest Fisheries Science Center
National Marine Fisheries Service
La Jolla, California 92038

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Introduction

An aerial survey was conducted over the Los Angeles Bight during April 13-15, 1982. The purpose of these flights was to 1) replicate the flight paths used during aerial surveys by Dohl et al., (1978), 2) gather data on the relative abundance of the short-finned pilot whale (Glogicephala macrorhynchus) in the area for comparsion with a concurrent survey from the research vessel DAVID STARR JORDAN, and 3) assess the suitability of a particular aircraft for surveying marine mammals using line transect methodology (Eberhardt et al., 1979).

Methods and Results

The California Department of Fish and Game (CDFG) provided 10 hours of flight time aboard a Beechcraft E18S aircraft. This aircraft had been converted to tricycle landing gear and retrofit with twin Pratt-Whitney PT6A-27 turbo-charged engines developing 680 horsepower each, which provided a cruising speed of 220 mph and slow flight at 95 mph during a survey. The plane was equipped with both radar and barometric altimeters, VOR navigation, and DME (distance measuring equipment). The interior floor of the aircraft provided four rectangular openings measuring 18 by 16 inches. One of these was fitted with a plexiglass covering used for downward veiwing by the observers. Additional viewing positions were available from both sides of the plane aft of the wing.

Six flights were conducted between April 13 and April 15, with one flight during the morning and a second during the afternoon. A total of fourteen transects were replicated (Figure 1). The survey team consisted of a downward-viewing "bow" observer and a data recorder. Occasionally, sightings were made by someone other than the "bow" observer and these (7 sightings) were not included as "on-effort" sightings. After transecting to a starting position, the aircraft flew a magnetic heading of either 210 degrees or 30 degrees at an altitude of 800-1000 feet and a ground speed of 90-105 knots. Positional data was recorded every ten minutes and whenever a sighting occurred. All data were coded onto forms developed in 1979 (Oliver 1983).

Fourteen tracklines were flown resulting in a total of 1278 linear, nautical miles surveyd under five different sea states, and providing 52 "on-effort" sightings (Table 1 and Figure 1). We obtained a total of 59 sightings including one "mixed" sighting of Risso's dolphins and bottlenose dolphins (Table 2). The data collected for all 59 sightings, by species, are shown in Table 3. Sightings were plotted and are presented in Figure 2 for cetaceans, and in Figure 3 for pinnipeds. The marine mammal species codes we used are presented in Table 4. A histogram of the perpendicular distances to sightings is shown in Figure 4.

Data Collection, Editing, and Archival

Aerial Survey Transect forms (Appendix I) were used to record geographical positions and time for a single unit of searching effort where all sighting conditions remained constant throughout a defined period of time. This period, recorded as a leg, continued as long as altitude (within 50 feet), ground speed, observer positions, sea state, sun position, and visibility were constant. If any of these characteristics changed, a new leg began with the updated conditions recorded. This procedure for recording units of searching effort was maintained during a flight with the following exceptions:

1. Transect record forms were used only during actual searching effort. Periods of time when the aircraft was enroute to areas of interest were not recorded as being on effort.

2. To reduce observer fatigue, observers were rotated among various duty stations at regular intervals (i.e., 45 minutes). If rotation could be accomplished with continuous observation, the legs were continuous.

3. Units of effort (Legs), were generally continuous during a flight. However, if any of the factors affecting sightability exceeded predetermined levels, the period of time involved was not recorded as being on effort.

4. When a sighting was made during a leg, and the aircraft diverted momentarily to investigate, the unit of continuous effort was maintained as a leg. The data elements "reason for position" and "searching" were used within a leg to indicate the temporary suspension of searching effort.

Thus, significant factors affecting sightability were recorded in continuous units of effort suspended only temporarily if the aircraft diverted from the trackline to investigate a sighting.

The Aerial Survey Sighting form (Appendix I) was used to code information concerning environmental conditions, geographic location, time, perpendicular distance, estimates of school size, species composition, photographs taken, etc., at the time of a cetacean observation. There were three categories of sightings

recorded during the surveys. The majority of sightings occurred during searching effort while the aircraft was in a "search mode". These sightings were referenced to the Transect Record by a sequential sighting number assigned by the recorder at the time of sighting, as well as by date, time, flight number and leg number. The second category of sightings were those made during a leg of effort but while the aircraft was temporarily diverted from a "searching mode" (usually to investigate another sighting). These sightings are referenced to the Transect Record as the former sightings. The third category reflects sightings made opportunistically while the aircraft was not in a "searching mode." These sightings are referenced to the Transect Record data by date, time and flight number.

Each observer rotated through a number of duty stations (bow, recorder, rest). In the recorder position, the observer had access to the instrumentation panel capable of supplying the necessary navigational and location information. All other information was furnished by the pilots or observers. Each observer kept a personal "Sighting Log" to record important details of a particular sighting and his school size estimates. These estimates were passed to the recorder after each sighting.

Computer programs were developed to assist in the editing of field data (Oliver and Butler, 1990). These editing programs allow one to specify acceptable range values for any data element, as well as criteria for the logical comparison of elements both within, and between, records. The 1982 data have been edited using documented programs developed during 1980. Appendices III indicates the range values specified for editing the 1982 data. Appendix IV contains the "logical error statements" which reflect specified comparisons among data elements for the 1982 data. These "logical errors" are numbered to reflect the logical comparisons for transect and sighting data. The numbering convention is as follows:

Logical Error Number	Record Comparisons
1 - 100	Single transect record
101 - 200	Single sighting record
201 - 300	Transect record to sighting record
301 - 400	Between transect records
401 - 500	Between sighting records

It is noted that both range and logical criteria were used to assist in the editing of data and as such do not necessarily reflect the rule for reconciliation of apparent errors.

Listings of the FORTRAN language computer programs used to edit the 1982 Aerial Survey data are maintained by the Southwest Fisheries Science Center, La Jolla, California.

Acknowledgements

The forms design and coding instructions were reviewed by J. Powers (NMFS, SEFC), R. Holt (NMFS, SWFC), and T. Jackson (NMFS, SWR, NOAA Corps.). P. Metcalf typed the manuscript. R. Holt, D. DeMaster, and A. Coan reviewed the manuscript. The author extends his thanks to these individuals for their assistance. The cooperation and participation of the California Department of Fish and Game especially that of Warden/Pilots Larry Heitz and Bob Cole, was invaluable. The author also wishes to extend his thanks to observers Larry Hansen and Bill Brinkerhoff (SWFC, NMFS) for their participation in the survey.

Literature Cited

Dohl, T. P., K. S. Norris, R. C. Guess, J. D. Bryant and M. W. Honig. 1978. Marine mammal and seabird surveys of the Southern California Bight area 1975-1978. Vol. III. Investigators' Reports. Part II - Cetacea of the Southern California Bight. Report to the Bureau of Land Management on contract AA550-CT7-36. 414 p.

Eberhardt, L. L., D. G. Chapman and J. R. Gilbert. 1979. A review of marine mammal census methods. Wildlife Monographs No. 63. 46 p.

Oliver, C. W. 1983. Documentation of aerial survey sighting and transect forms for the 1977 and 1979 eastern tropical Pacific cetacean surveys. SWFC Admin. Rep. No. LJ-83-20, Southwest Fisheries Center, La Jolla, California. 39 p.

Oliver, C. W., and R.L. Butler. 1991. Documentation of the 1980 data verification programs and common subroutines for fixed-format data: porpoise data management system. NOAA-TM-NMFS-SWFSC-157. 69 p.

Table 1. Summary of on-effort sightings, by observer and Beaufort, as obtained from an aerial survey during April, 1982.

Beaufort	Observer 6			Observer 12			Observer 13			Combined		
	On-effort Sightings	Linear nmi Searched	S/nmi	On-effort Sightings	Linear nmi Searched	S/nmi	On-effort Sightings	Linear nmi Searched	S/nmi	On-effort Sightings	Linear nmi Searched	S/nmi
1	0	0	-	4	20.6	.1942	0	0	-	4	20.6	.1942
2	3	57.3	.0524	2	72.1	.0277	5	40.5	.1235	10	169.9	.0589
3	5	129.6	.0386	7	199.1	.0352	5	99.2	.0504	17	427.9	.0397
4	4	89.2	.0448	1	110.1	.0091	4	149.0	.0268	9	348.3	.0258
5	5	135.2	.0370	0	43.9	.0000	7	130.1	.0538	12	309.2	.0388
Combined	17	411.3	.0413	14	445.8	.0314	21	418.8	.0501	52	1275.9	.0408

Table 2. Summary, by species or type, of sightings obtained during an aerial survey off southern California during April of 1982.

Species	Species Code	Type of Sighting Pure	Type of Sighting Mixed	Mean LOW Estimate	Mean HIGH Estimate	Mean BEST Estimate
Bottlenose dolphin (Tursiops truncatus	18	6	1	3.26(7)	4.11(7)	3.45(7)
Risso's dolphin (Grampus griseus)	21	11	1	8.35(12)	12.93(12)	10.24(12)
Northern right whale dolphin (Lissodelphis borealis)	27	1	0	4.00(1)	4.00(1)	24.00(1)
Dall's porpoise (Phocoenoides dalli)	44	8	0	5.13(8)	7.88(8)	6.38(8)
Gray whale (Eschrichtius robustus)	69	3	0	1.67(3)	1.67(3)	1.67(3)
Unidentified dolphin or porpoise	77	4	0	4.50(4)	5.25(4)	5.00(4)
Unidentified small whale	78	3	0	3.00(3)	4.00(3)	3.33(3)
California sea lion (Zalophus californianus)	91	5	0	3.00(5)	6.00(5)	4.00(5)
Unidentified pinniped	97	14	0	1.29(14)	1.64(14)	1.29(14)
Unidentified whale	98	2	0	1.00(2)	1.00(2)	1.00(2)
Unidentified cetacean	99	1	0	17.00(1)	17.00(1)	17.00(1)
TOTALS		58	1			

Table 3. Marine mammal sightings at sea, classified by species code groups, as obtained during an aerial survey conducted off southern California during April 1982.

Marine Mammal Species Code	Number of Animals	Dist. From Track (nmi)	Sighting Number	GMT Date (YY MM DD)	GMT Time	Flight and Leg Numbers	Position Lat.	Position Long.	On=1 Off=2 Effort	L=Left C=Center R=Right Observer	Sighter Code	Beaufort	Sun Position Hor.	Sun Position Ver.
						Bottlenose dolphin (Tursiops truncatus)								
18	3	0.0	1.1	82 4 13	1637.2	1 1	33 36 N	118 26 W	1	C	13	2	8	1
18	5	0.4	5.1	82 4 13	1653.7	1 2	33 20 N	118 47 W	2	R	12	3	8	1
18	4	0.0	7.1	82 4 13	1843.3	1 8	33 1 N	118 46 W	1	C	12	4	4	12
18	3	0.0	10.1	82 4 13	1858.0	1 9	33 17 N	118 24 W	1	C	12	2	4	12
18	4	0.3	30.2	82 4 14	1758.7	3 1	34 13 N	121 6 W	1	R	13	3	9	1
18	4	0.1	40.1	82 4 14	2009.1	3 9	34 5 N	120 4 W	1	L	13	5	6	12
18	1	0.0	58.1	82 4 15	2016.7	6 1	33 6 N	117 24 W	1	R	6	2	11	12
						Risso's dolphin (Grampus griseus)								
21	50	0.4	12.1	82 4 13	1905.0	1 10	33 26 N	118 14 W	2	R	6	1	4	12
21	8	0.4	18.1	82 4 13	2223.0	2 5	32 50 N	120 21 W	2	R	6	3	12	1
21	10	0.1	19.1	82 4 13	2228.0	2 5	32 42 N	120 35 W	1	R	12	3	12	1
21	5	0.1	21.1	82 4 13	2310.7	2 6	32 45 N	120 13 W	1	R	6	3	7	1
21	15	0.3	28.1	82 4 14	1756.7	3 1	34 16 N	121 5 W	1	R	13	3	9	1
21	2	0.1	29.1	82 4 14	1757.0	3 1	34 15 N	121 5 W	1	R	12	3	9	1
21	14	0.3	30.1	82 4 14	1758.7	3 1	34 13 N	121 6 W	1	R	13	3	9	1
21	5	0.8	32.1	82 4 14	1830.7	3 2	34 12 N	120 41 W	1	L	6	3	3	1
21	2	0.2	33.1	82 4 14	1831.7	3 2	34 13 N	120 40 W	1	L	6	3	3	1
21	1	0.1	34.1	82 4 14	1832.0	3 2	34 13 N	120 40 W	1	L	13	3	3	1
21	5	0.4	38.1	82 4 14	1947.0	3 7	33 38 N	120 31 W	1	L	13	3	4	12
21	11	0.3	48.1	82 4 14	2349.5	4 6	33 14 N	120 18 W	1	R	6	5	8	2
						Northern right whale dolphin (Lissodelphis borealis)								
27	24	0.3	26.1	82 4 14	2.0	2 10	33 41 N	118 53 W	2	R	6	3	7	2
						Dall's porpoise (Phocoenoides dalli)								
44	1	0.2	15.1	82 4 13	1909.7	1 10	33 34 N	118 2 W	1	L	12	1	4	12
44	5	0.1	17.1	82 4 13	2158.5	2 4	33 15 N	119 45 W	1	L	13	4	12	12
44	8	0.1	41.1	82 4 14	2011.4	3 9	34 8 N	120 1 W	1	L	13	5	6	12
44	8	0.1	42.1	82 4 14	2011.6	3 9	34 8 N	120 0 W	1	L	13	5	6	12
44	15	0.0	43.1	82 4 14	2012.4	3 9	34 10 N	120 0 W	1	C	13	5	6	12
44	7	0.0	44.1	82 4 14	2013.1	3 9	34 11 N	119 59 W	1	L	13	5	6	12
44	6	0.1	49.1	82 4 15	0.8	4 7	33 17 N	120 12 W	1	L	13	5	8	2
44	1	0.0	51.1	82 4 15	13.3	4 8	33 33 N	119 57 W	1	R	6	5	8	2
						Gray whale (Eschrichtius robustus)								
69	1	0.3	16.1	82 4 13	2118.0	2 1	33 58 N	118 50 W	2	L	12	2	12	12
69	2	0.0	35.1	82 4 14	1849.0	3 4	34 27 N	120 13 W	2	C				
69	2	0.0	45.1	82 4 14	2027.0	3 10	34 24 N	119 42 W	2		6			

Table 3. continued.

Marine Mammal Species Code	Number of Animals	Dist. From Track (nmi)	Sighting Number	GMT Date (YY MM DD)	GMT Time	Flight and Leg Numbers	Position Lat.	Position Long.	On=1 Off=2 Effort	L=Left C=Center R=Right Observer	Sighter Code	Beaufort	Sun Position Hor.	Sun Position Ver.
						Unidentified dolphin or porpoise								
77	1	0.2	31.1	82 4 14	1800.7	3 1	34 10 N	121 7 W	1	R	13	3	9	1
77	4	0.1	52.1	82 4 14	27.7	4 8	33 47 N	119 33 W	1	L	6	5	8	2
77	12	0.0	53.1	82 4 15	29.2	4 8	33 49 N	119 30 W	1	C	6	5	8	2
77	3	0.4	56.1	82 4 15	1850.6	5 10	32 59 N	118 3 W	1	L	6	4	3	1
						Unidentified small whale								
78	8	0.0	20.1	82 4 13	2241.0	2 5	32 29 N	120 56 W	1	C	12	3	12	1
78	1	0.1	50.1	82 4 15	5.7	4 7	33 23 N	120 6 W	1	R	6	5	8	2
78	1	0.1	59.1	82 4 15	2031.9	6 3	32 50 N	117 42 W	1	R	6	3	11	12
						California sea lion (Zalophus californianus)								
91	2	0.2	4.1	82 4 13	1643.6	1 1	33 29 N	118 37 W	1	L	13	2	8	1
91	1	0.0	37.1	82 4 14	1944.8	3 7	33 35 N	120 33 W	1	C	12	3	4	12
91	1	0.2	46.1	82 4 14	2217.4	4 1	34 10 N	119 35 W	1	L	6	2	12	12
91	1	0.2	47.1	82 4 14	2219.1	4 1	34 9 N	119 38 W	1	R	6	2	12	12
91	15	0.2	57.1	82 4 15	2016.5	6 1	33 6 N	117 23 W	1	R	13	2	11	12
						Unidentified pinniped								
97	1	0.2	2.1	82 4 13	1641.6	1 1	33 34 N	118 28 W	1	R	13	2	8	1
97	1	0.0	3.1	82 4 13	1642.9	1 1	33 32 N	118 32 W	1	C	13	2	8	1
97	1	0.0	8.1	82 4 13	1849.9	1 8	33 8 N	118 36 W	1	C	12	3	4	12
97	1	0.1	9.1	82 4 13	1853.6	1 9	33 13 N	118 30 W	1	R	12	2	4	12
97	1	0.0	13.1	82 4 13	1905.7	1 10	33 28 N	118 11 W	1	C	12	1	4	12
97	1	0.1	14.1	82 4 13	1906.3	1 10	33 32 N	118 8 W	1	L	12	1	4	12
97	1	0.2	22.1	82 4 13	2315.7	2 6	32 53 N	120 5 W	1	L	6	3	7	1
97	1	0.1	23.1	82 4 13	2330.3	2 8	33 9 N	119 38 W	1	L	13	4	7	1
97	1	0.0	25.1	82 4 13	2343.0	2 8	33 16 N	119 19 W	1	L	13	4	7	1
97	1	0.1	27.1	82 4 14	1739.4	3 1	34 35 N	120 42 W	1	R	12	3	9	1
97	5	0.0	39.1	82 4 14	2008.9	3 9	34 5 N	120 5 W	1	L	13	5	6	12
97	1	0.1	54.1	82 4 15	1733.4	5 5	32 50 N	118 30 W	1	R	6	4	8	1
97	1	0.0	55.1	82 4 15	1733.9	5 5	32 50 N	118 32 W	1	L	6	4	8	1
						Unidentified whale								
98	1	0.0	24.1	82 4 13	2330.4	2 8	33 10 N	119 33 W	1	L	13	4	7	1
98	1	0.4	36.1	82 4 14	1912.3	3 6	34 5 N	120 32 W	1	R	12	3	9	1
						Unidentified cetacean								
99	17	0.0	6.1	82 4 13	1739.4	1 4	32 32 N	119 58 W	1	C	6	4	8	1

e 4. The code table used by the Coastal Marine Mammal Project (NMFS) to identify, by numeric codes, species and stocks of cetaceans, pinnipeds, and other marine mammals.

ies le	Short Name	Code Table 15 Marine Mammal Codes			Scientific Name
	Unid. delph	(1981-	)	unidentified common dolphin	Delphinus delphis
	Streaker	(1981-	)	unidentified striped dolphin	Stenella coeruleoalba
	Tursiops	(1981-	)	unidentified bottlenose dolphin	Tursiops truncatus
	Grampus	(1981-	)	Risso's dolphin	Grampus griseus
	Lagenorhynchus	(1981-	)	Pacific white-sided dolphin	Lagenorhynchus obliquidens
		(1981-	)	Dusky dolphin	Lagenorhynchus obscurus
	Lissodelphis	(1981-	)	northern right whale dolphin	Lissodelphis borealis
	Peponocephala	(1981-	)	melon-headed whale	Peponocephala electra
	Feresa	(1981-	)	pygmy killer whale	Feresa attenuata
	Pseudorca	(1981-	)	false killer whale	Pseudorca crassidens
	Globicephala	(1981-	)	unidentified pilot whale	Globicephala sp.
	Globicephala	(1981-	)	long-finned pilot whale	Globicephala melaena
	Globicephala	(1981-	)	short-finned pilot whale	Globicephala macrorhynchus
		(1981-	)	killer whale	Orcinas orca
		(1981-	)	harbor porpoise	Phocoena phocoena
		(1981-	)	Cochito	Phocoena sinus
		(1981-	)	Dall's porpoise	Phocoenoides dalli
		(1981-	)	sperm whale	Physeter catodon
		(1981-	)	pygmy sperm whale	Kogia brevicops
		(1981-	)	dwarf sperm whale	Kogia simus
		(1981-	)	unidentified beaked whale	Ziphiid
	Mesoplodont	(1981-	)	unidentified mesoplodon	Mesoplodon sp.
		(1981-	)	Cuvier's beaked whale	Ziphius cavirostris
		(1981-	)	Arnoux's beaked whale	Beradius arnouxi
		(1981-	)	Shepherd's beaked whale	Tasmacetus shepherdi
		(1981-	)	gray whale	Eschrichtius robustus
	Unid. rorqual	(1981-	)	Unidentified rorqual	Balaenoptera sp.
		(1981-	)	Minke whale	B. acutorostrata, B. bonaerensis
		(1981-	)	Bryde's whale	Balaenoptera edeni
		(1981-	)	Sei whale	Balaenoptera borealis
		(1981-	)	fin whale	Balaenoptera physalus
		(1981-	)	blue whale	Balaenoptera musculus
	Humpback whale	(1981-	)	humpback whale	Megaptera novaeangline
	Unid. porpoise	(1981-	)	unidentified dolphin or porpoise	
	Unid. Sml. Whale	(1981-	)	unidentified small whale	
	Unid. Lrg. Whale	(1981-	)	unidentified large whale	
	S. Sea Otter	(1981-	)	Southern sea otter	Enhydra lutris nereis
	Sea lion	(1981-	)	California sea lion	Zalophus californianus
	Elephant seal	(1981-	)	northern elephant seal	Mirounga angustirostris
	Harbor seal	(1981-	)	harbor seal	Phoca vitulina richardsi
	N. fur seal	(1981-	)	Pribilof fur seal	Callorhinus ursinus
	Steller sea lion	(1981-	)	Steller sea lion	Eumetopias jubatus
	S. fur seal	(1981-	)	Guadalupe fur seal	Arctocephalus townsendi
		(1981-	)	unidentified pinniped	
		(1981-	)	unidentified whale	
		(1981-	)	unidentified cetacean	

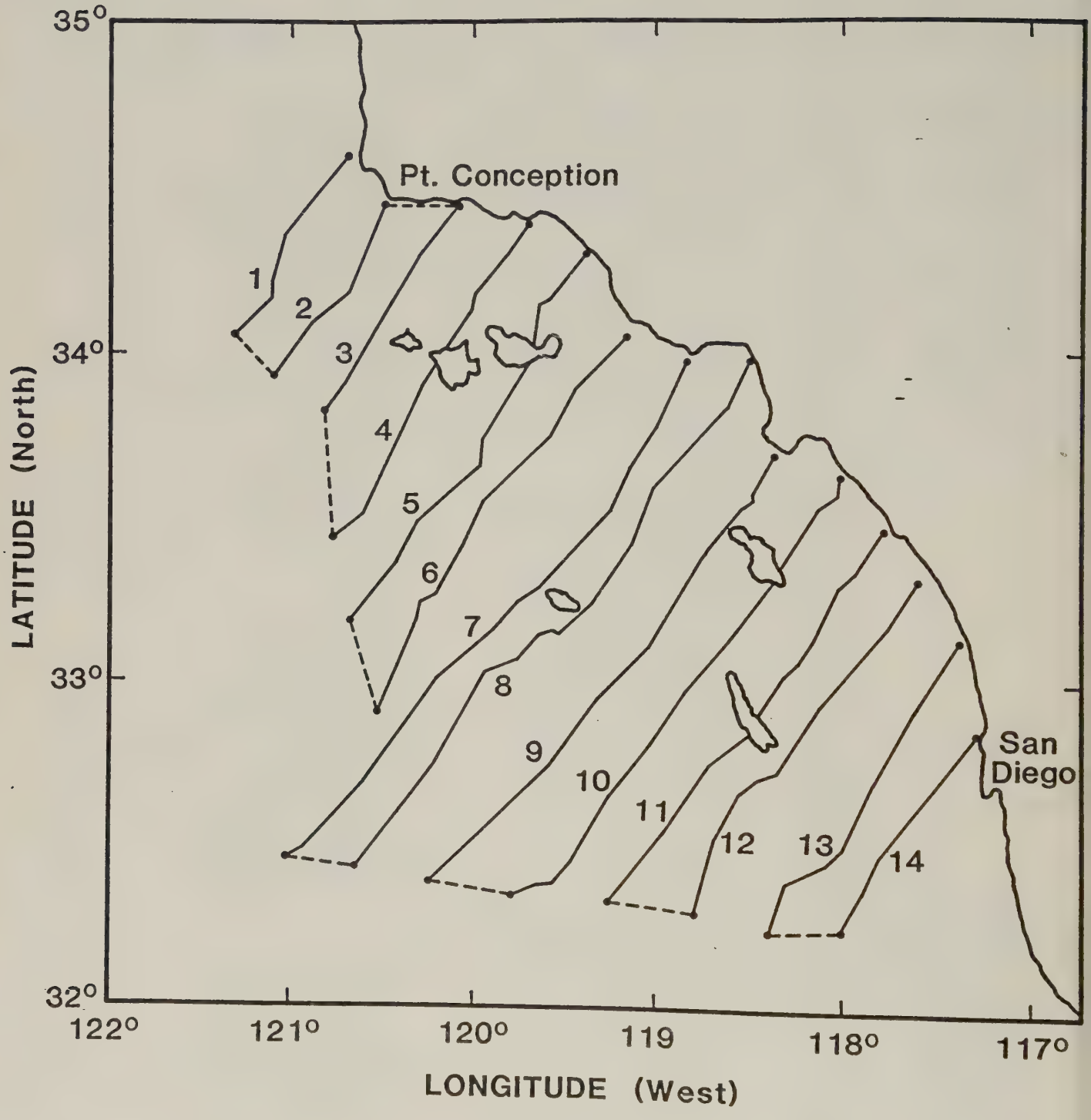

Figure 1. Tracklines flown during an aerial survey of the Los Angeles Bight during April 13-15, 1982. Solid lines indicate areas of observational effort. Dashed lines indicate the non-searched areas between tracklines.

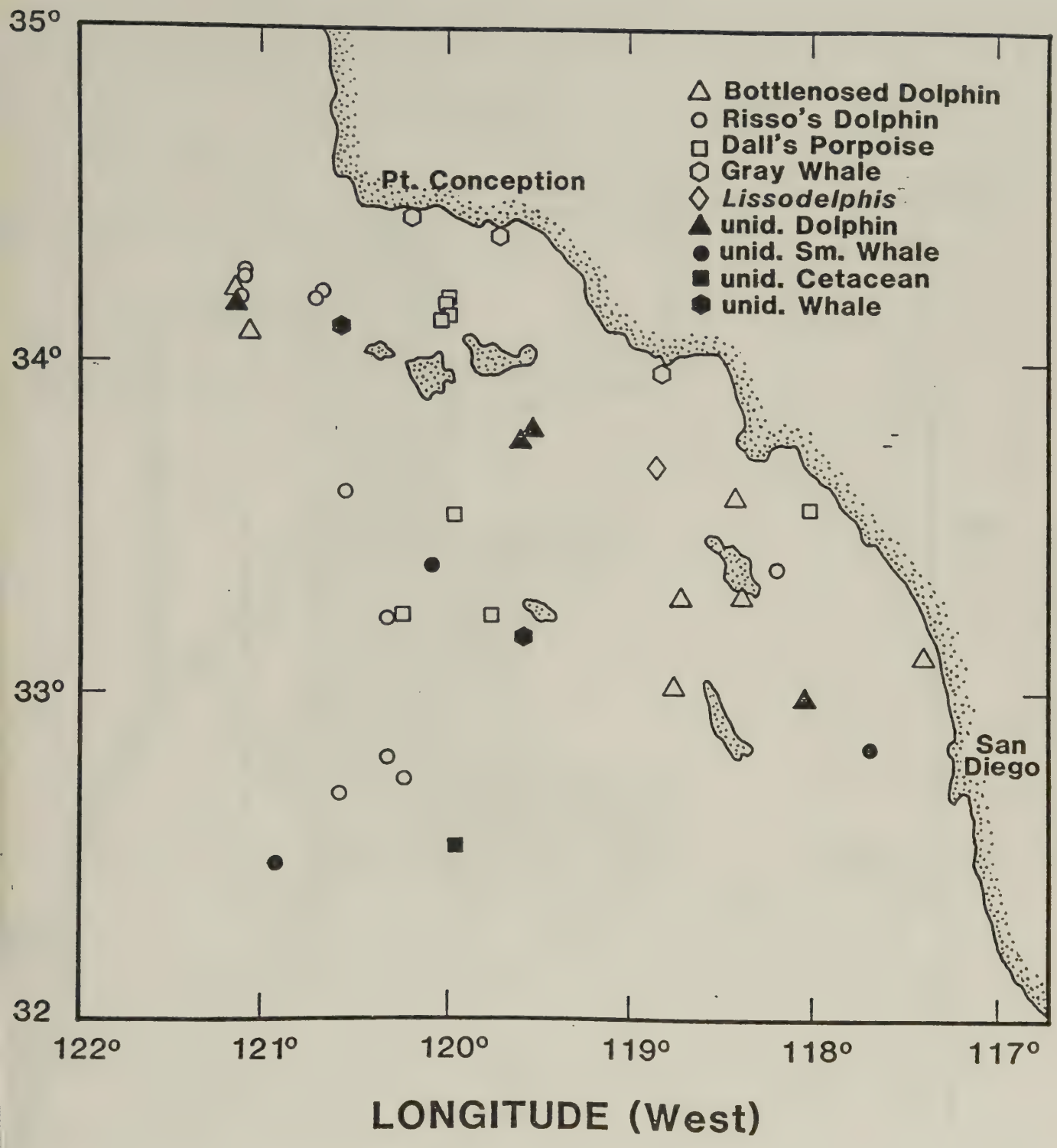

Figure 2. Distribution of sightings of cetaceans obtained during aerial survey flights during April 13-15, 1982.

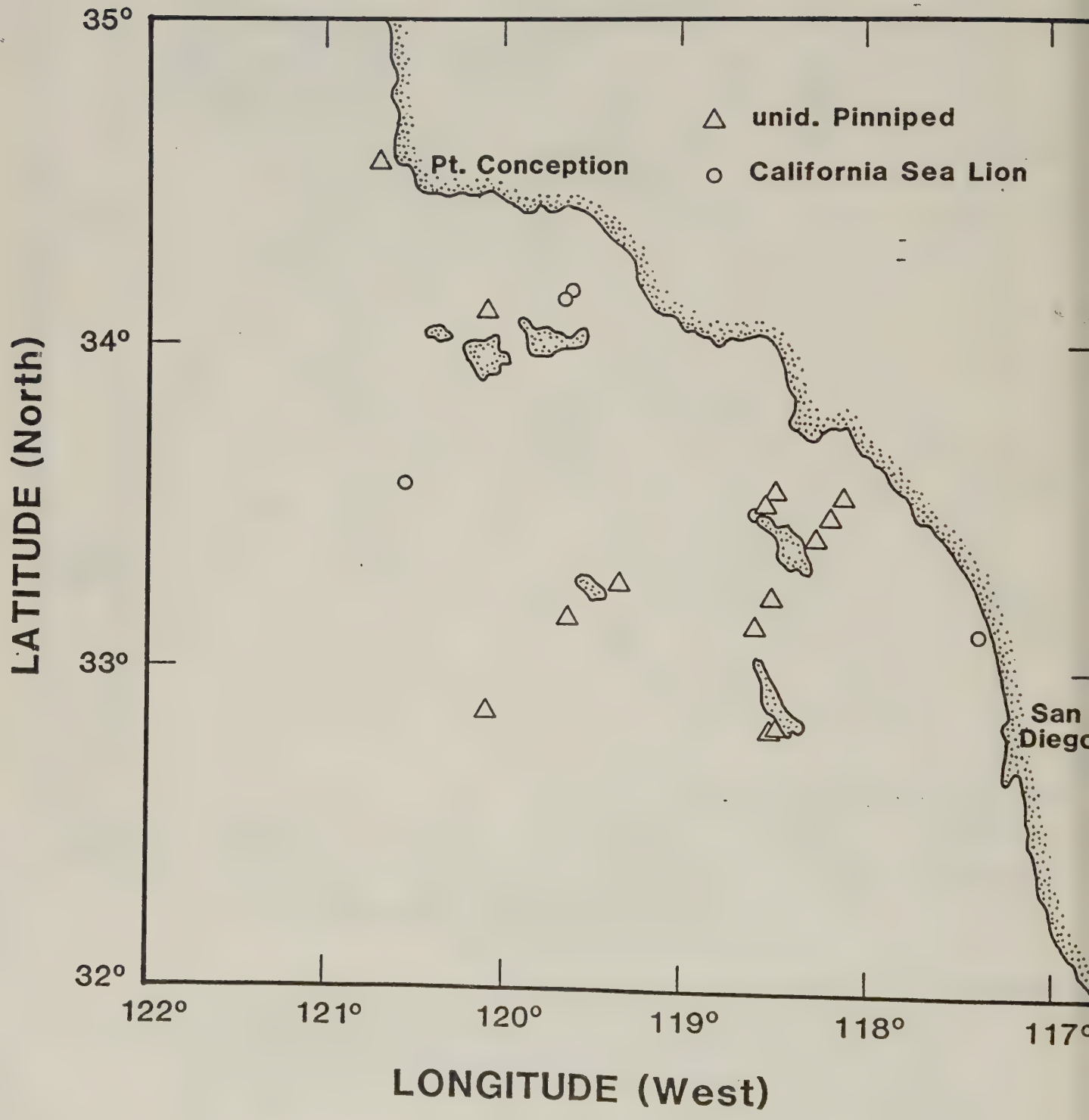

Figure 3. Distribution of sightings of pinnipeds obtained during aerial survey flights during April 13-15, 1982.

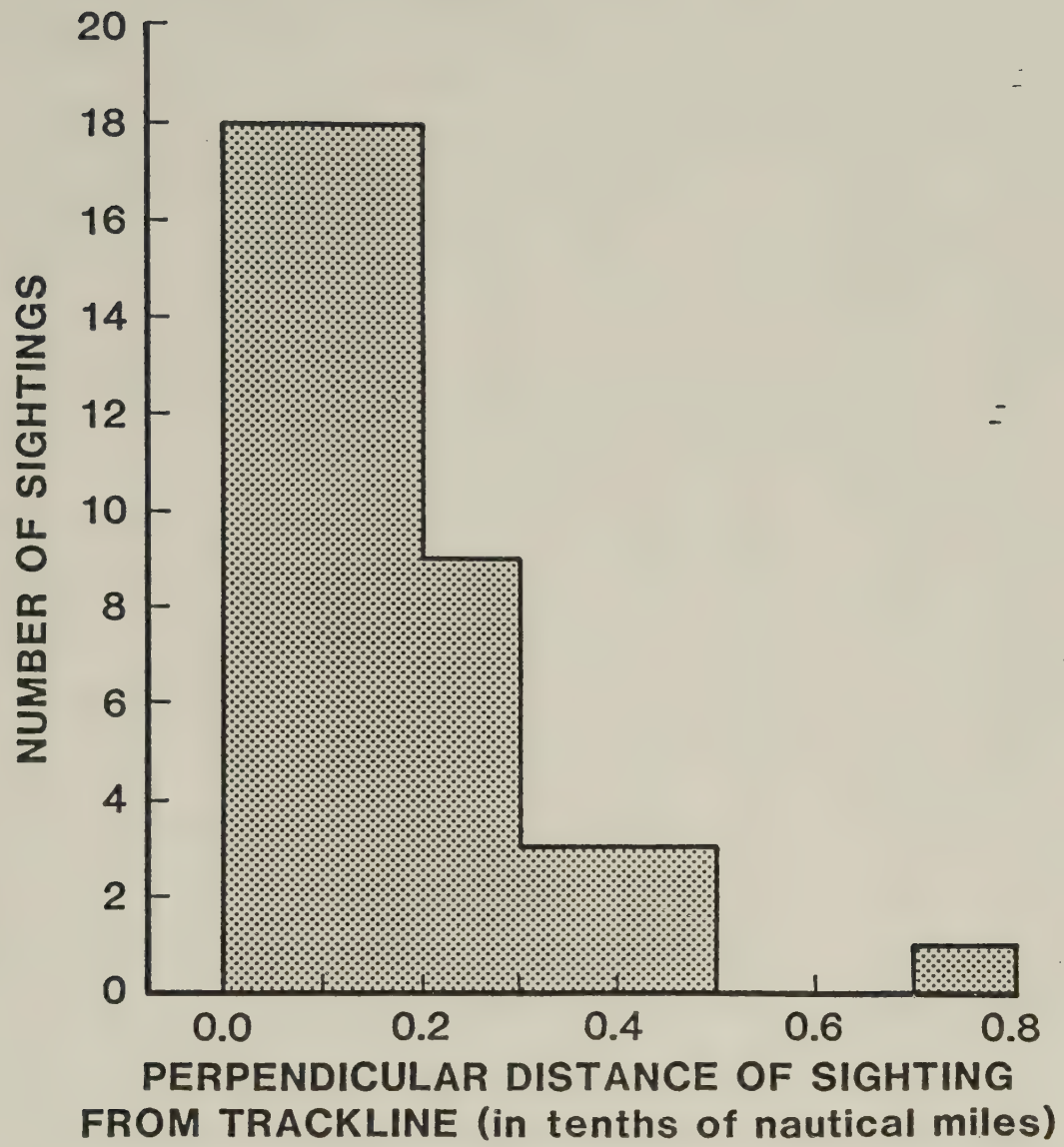

Figure 4. Histogram of the estimated perpendicular distance from the trackline to a marine mammal sighting as obtained during an aerial survey conducted April 13-15, 1982. All 52 "on-effort" sightings are represented.

Appendix I. The field and coding forms used during a 1982 aerial survey.

1979 AERIAL SURVEY TRANSECT RECORD

FLIGHT: _____ LEG: _____ DATE: _____

FROM. _____ TO. _____

BLANK	FLIGHT NO.	LEG NO.	DATE YR	DATE MO	DATE DAY	ALTITUDE (FEET)	GROUND SPEED (KNOTS)
X							
1	4	6	8	10	12	14	18

OBSERVER CODES

BOW	BLANK	LEFT WAIST	RIGHT WAIST	RECORDER	SUN POSITION HORIZ.	SUN POSITION VERT	BEAUFORT NO.
	X						
21	22	23	24	25	31	32	35

REASON FOR POSITION
1. Begin Leg
2. Track Check
3. Divert
4. Overschool
5. Return
6. End Leg

LATITUDE DEG.	LATITUDE MIN.	N/S	LONGITUDE DEG.	LONGITUDE MIN.	E/W	G.M.T.		SEARCHING Y/N	SIGHTING NO.
36	38	41	42	45	48	49	53	54	55	56	58

NOAA FORM No. 88-174 1/79

1979 AERIAL SURVEY SIGHTING RECORD

GMT

SIGHTING NO.	FLIGHT NO.	LEG NO.	CARD NO.	DATE YR	DATE MO	DATE DAY	OBSERVER CODES BOW	LEFT WAIST	RIGHT WAIST	RECORDER
			1							
1	4	6	8	9	11	13	15	17	19	21

OBSERVER CODES
1. BARHAM
2. CHARTER
3. COE
4. JACKSON
5. LEATHERWOOD
6. OLIVER
7. POWERS
8. WALKER
9. PERRYMAN
10. HOLT

CLOCK POSITION OF SUN HORIZ	CLOCK POSITION OF SUN VERT	SEA SURF. TEMP. (°F + TENTHS)	BEAUFORT NO.	SIGHT BY WHOM
23	25	27	30	31

1 DISTANCE (N.M.)	DISTANCE DETERMINED 1. GNS 2. ESTIMATED 3. INCLINOMETER	L R
33	36	

POSITION OF SCHOOL LATITUDE DEG	MIN.	N/S	LONGITUDE DEG	MIN.	E/W
37	39	41	42	45	47

	SCHOOL SIZE ESTIMATES OBS. CODE	BEST	HIGHEST	LOWEST	SPECIES °:	CODE	NAME
					(1)		
	48	50	54	58	62	65	

SIGHTING NO.	CARD NO.							
	2					(2)		
1	4	5	7	11	15	19	22	
						(3)		
		24	26	30	34	38	41	
						(4)		
		43	45	49	53	57	60	
						(5)		
		62	64	68	72	76	79	

SIGHTING NO.	CARD NO.				
	3				
1	4	5	7	11	15

PORPOISE 19 BIRDS 20 TUNA 21

ALTITUDE 9" PHOTOS	70 mm CAMERA ROLL NO	1st. FRAME	LAST FRAME	9" CAMERA ROLL NO.	1st. FRAME	LAST FRAME	35 mm CAMERA ROLL NO.	1st. FRAME	LAST FRAME
22 26	27	30	33	36	39	42	45	48	51

26-SCHOOL MODE AT TIME OF 9" PHOTOS
1. TRAVELING
2. RESTING
3. FEEDING

Y/N WAS PLANE IN SEARCH MODE, 54

Appendix II. The data coding formats for TRANSECTS and SIGHTINGS obtained during a 1982 aerial survey.

1982 Aerial survey transect record coding format.

Columns	Data Element	Explanation or Reference
		Record 1 of 1
1-3	Left blank to allow for machine merging with sighting record format.	
4-5	Flight No.	A consecutive number assigned to each flight of the survey.
6-7	Leg No. (1 to N)	A consecutive number assigned to each of the legs within a particular flight. Leg (1) begins with start of effort and Leg (n) ends upon termination of effort for the day.
8-9	Year (YR)	The Greenwich Mean Time (GMT) year the leg was flown.
10-11	Month (MO)	The GMT month the leg was flown.
12-13	Day	The GMT day the leg was flown.
14-17	Altitude	The altitude (in feet) of the aircraft at the start of each leg.
18-20	Ground speed	The aircraft's estimated speed (in knots) over the water recorded at the start of each leg.
21-22	Bow	The numeric code identifying the individual occupying the downward-viewing observation station (see Sighting Record for codes).
23-24		Blank.
25-26	Left waist	The numeric code identifying the individual occupying the left side observation station.
27-28	Right waist	The numeric code identifying the individual occupying the right side observation station.
29-30	Recorder	The numeric code identifying the individual occupying the recorder station.

1982 Aerial survey transect record coding format - Continued

Columns	Data Element	Explanation or Reference
31-32	Horizontal sun position[1] (HORIZ)	At the beginning of the leg, the sun's horizontal clock position in relation to the bow of the aircraft.
3-34	Vertical Sun Position (VERT)	Sun's vertical position from the horizon to directly overhead using the clock hours (VERT) between 12 and 3 (i.e. 3, 2, 1, 12 for overhead).
35	Beaufort No.	Sea state conditions according to the Beaufort scale numeric codes (Table 3).
36-40	Latitude	The latitude in degrees (2 digits), minutes (2 digits), and tenths of minutes (1 digit).
41	N/S	Numeric code indicating north or south latitude. North = 1, South = 2.
42-47	Longitude	The longitude in degrees (3 digits), minutes (2 digits), and tenths of minutes (1 digit).
48	E/W	Numeric code indicating east or west longitude. East = 1, West = 2.
49-53	GMT	Greenwich Mean Time in which position was recorded in hours, minutes, and tenths of minutes (based on 24 hour clock).
54	Reason for Position	Numerically coded reason for recording time and position (See Transect Form, Figure 1, for codes).

[1]Blanks for both horizontal and vertical position of the sun (columns 31-34) indicated that the sun was obscured by clouds. During the 1982 survey, a 12 was entered for horizontal and vertical sun positions to indicate the sun was directly overhead.

1982 Aerial survey transect record coding format - Continued

Columns	Data Element	Explanation or Reference
55	Searching[2] (Y/N)	A numerically coded answer to the question: "was the aircraft engaged in searching effort when the time and position were recorded?" Yes = 1, No : 2.
56-58	Sighting No.	A consecutive number assigned to each sighting of marine mammals, from 1 to 999, throughout the survey over all flights.

USAGE NOTES

Each time a position was taken and associated information collected (columns 36-58), a new record was punched. Columns 1-35 were repeated for each position, i.e., for each record within a leg.

Legs were generally 45 minutes in length. This corresponded to observer watches of 45 minutes. At the end of a watch the observer crew rotated. There were two duty stations for observers and one rest station. Sometimes because of sighting activity the watch was extended to facilitate recording of the data. Legs were concluded if sighting conditions changed or if the watch ended.

[2]The plane was not in the search mode (column 55 was equal to 2), if the trackline could not be guarded, i.e., if the basic assumption of transect theory that the probability of sighting an object on the trackline being unity could not be met. Also, the plane was not in the search mode if the reason for taking a position (column 54) was either three or four, indicating the plane had diverted from the trackline.

1982 Aerial survey sighting record coding format.

Columns	Data Element	Explanation or Reference
		Record 1 of 3
1-3	Sighting No.	A consecutive number assigned to each sighting of marine mammals during all flights of survey.
4-5	Flight No.	A consecutive number assigned to each flight of survey indicating the temporal location of the sighting.
6-7	Leg No.	A consecutive number assigned to each leg of a particular flight indicating the temporal location of the sighting.
8	Card No.	The number representing the record (1, 2 or 3) associated with this sighting.
9-10	Year (YR)	The Greenwich Mean Time (GMT) year the sighting was made.
11-12	Month MO)	The GMT month the sighting was made.
13-14	Day	The GMT day the sighting was made.
15-16	Bow	The numeric code identifying the individual occupying the downward-viewing observation station at time of sighting (see form for codes).
17-18	Left waist	The numeric code identifying the individual occupying the left side observation station at time of sighting.
19-20	Right waist	The numeric code identifying the individual occupying the right side observation station at time of sighting.
21-22	Recorder	The numeric code identifying the individual occupying the recorder position at time of sighting.

1982 Aerial survey sighting record coding format - Continued

Columns	Data Element	Explanation or Reference
23-24	Horizontal Sun Position[1] (HORIZ)	At the time of sighting, the sun's horizontal clock position in relation to the bow of the aircraft.
25-26	Vertical Sun Position[1] (VERT)	Sun's vertical position from the horizon to directly overhead using the clock hours between 12 and 3, at time of sighting (i.e. 3, 2, 1, 12 for overhead).
27-29	Sea Surf.	Temp Sea surface temperature in of and tenths as measured by an onboard infraradiometer.
30	Beaufort No.	Sea state conditions according to the Beaufort scale codes (Table 3) at the time of sighting.
31-32	Sighted by whom	The numeric code identifying the individual who first made the sighting.
33-35	Distance (N.M)	The perpendicular distance, in nautical miles and tenths, between the aircraft and the sighting.
36	Dist. determined	The numeric code for how the perpendicular distance was computed 1 = GNS, 2 = estimated, 3 = inclinometer.
	L/R	Indicator showing the side of the aircraft trackline where sighting occurred. Not collected in 1977 (L = Left, R = Right).
37-40	Latitude	The latitude in degrees (2 digits), and minutes (2 digits) at time of sighting, or when over the sighting.

[1]During the 1982 survey, a 12 was entered for horizontal and vertical sun positions to indicate the sun was directly overhead.

1982 Aerial survey sighting record coding format - Continued

Columns	Data Element	Explanation or Reference
41	N/S	Numeric code indicating north or south latitude North = 1, South = 2.
42-46	Longitude	The longitude in degrees (3 digits), and minutes (2 digits) at time of sighting, or when over the sighting.
47	E/W	Numeric code indicating east or west longitude. East = 1, West = 2.
48-49	Obs. Code	The numeric code identifying the observer making the school size estimates for this sighting.
50-53	Best	The best estimate, for this sighting, of the number of marine mammals sighted by the observer indicated in columns 48-49.
54-57	Highest	The highest number of marine mammals estimated for this sighting by the observer indicated in columns 48-49.
58-61	Lowest	The lowest number of marine mammals estimated for this sighting by the observer indicated in columns 48-49.
62-64	Species 1 percent estimate	The estimated percentage of the total aggregate represented by the species indicated as species (1).
65-66	Species 1 code[2]	The numeric code identifying the species indicated as species (1) (Table 4).

[2]Species codes are similar to those employed by the NMFS tuna vessel observers (Code Table 15).

1982 Aerial survey sighting record coding format - Continued

Columns	Data Element	Explanation or Reference
		Record 2 of 3
1-3	Sighting No.	The consecutive number assigned to this sighting of marine mammals, same as Record 1.
4	Card No.	The number representing the record (1, 2 or 3) associated with this sighting.
5-6	Obs. code	The numeric code identifying the observer making school size estimates for this sighting.
7-10	Best	The best estimate, for this sighting, of the number of marine mammals sighted by the observer indicated in columns 5-6.
11-14	Highest	The highest number of marine mammals estimated for this sighting by the observer indicated in columns 5-6.
15-18	Lowest	The lowest number of marine mammals estimated for this sighting by the observer indicated in columns 5-6.
19-80		These columns were not used.

1982 Aerial survey sighting record coding format - Continued

Columns	Data Element	Explanation or Reference
		Record 3 of 3
Card 3		
1-3	Sighting No.	The consecutive number assigned to this sighting of marine mammals, same as Record 1.
4	Card No.	The number representing the record (1, 2 or 3) associated with this sighting.
5-18		These columns were not used.
19	Cetaceans	The numerically coded answer to the question: "were cetaceans present with this sighting?" Coded Yes = 1, No = 2.
20	Birds	The numerically coded answer to the question: "were birds present with this sighting?" Coded Yes = 1, No = 2.
21	Fish	The numerically coded answer to the question: "were fish present with this sighting?" Coded Yes = 1, No = 2.
22-53		These columns were not used.
54	Searching cue (WAS PLANE IN SEARCH MODE?)	The numerically coded answer to the question: "Was the plane in a searching mode at the time of sighting?". Coded Yes = 1, No = 2.

Appendix III. The blankness and range criteria used to edit 1982 aerial survey TRANSECTS and SIGHTINGS data.

1982 AERIAL TRANSECT FORM
Data Element Blankness and Range Editing Specifications
Record 1 of 1

Data Element	Columns	Character type	Blankness OK?	Range Lower	Range Upper
Flight number	4- 5	N	No	1	6
Leg number	6- 7	N	No	1	12
Year	8- 9	N	No	82	82
Month	10-11	N	No	4	4
Day	12-13	N	No	13	15
Altitude (feet)	14-17	N	No	750	1000
Ground speed (knots)	18-20	N	Yes	90	110
Bow obs code	21-22	N	No	6	13
Left obs code	25-26	N	Yes	6	13
Right obs code	27-28	N	Yes	6	13
Recorder code	29-30	N	No	4	13
Horizontal sun code	31-32	N	Yes	1	12
Vertical sun code	33-34	N	Yes	1	12
Beaufort	35	N	No	1	5
LATD (latitude Degs)	36-37	N	No	32	34
Latitude minutes (no 10ths)	38-39	N	No	1	59
Latitude minutes to 10ths	40	N	No	0	9
N or S (Hemisphere)	41	N	No	1	1
LONGD (Longitude Degs)	42-44	N	No	117	121
Longitude minutes (no 10ths)	45-46	N	No	1	59
Longitude minutes to 10ths	47	N	No	0	9
E or W (Hemisphere)	48	N	No	2	2
Greenwich time	49-52	N	No	0	2359
GMT to 10ths	53	N	No	0	9
Reason position	54	N	No	1	6
Searching	55	N	No	1	2
Sighting number	56-58	N	Yes	1	59

A = ALPHA B = BLANK C = COMMA N = NUMERIC

1982 AERIAL SIGHTING FORM
Data Element Blankness and Range Editing Specifications
Record 1 of 3

Data Element	Columns	Character type	Blankness OK?	Range Lower	Range Upper
Sight number	1- 3	N	No	1	59
Flight number	4- 5	N	No	1	6
Leg number	5- ?	N	No	1	12
Year	?-10	N	No	82	82
Month	11-12	N	No	4	4
Day	13-14	N	No	13	15
Bow obs code	15-16	N	No	6	13
Left obs code	17-18	N	Yes	6	13
Right obs code	19-20	N	Yes	6	13
Recorder code	21-22	N	No	6	13
Horizontal sun code	23-24	N	Yes	1	12
Vertical sun code	25-26	N	Yes	1	12
Sea surface temp (degs F)	27-28	N	Yes	60	65
Sea surface temp to 10ths	29	N	Yes	0	9
Beaufort	30	N	No	1	5
Sighter code	31-32	N	No	6	13
Perpendicular distance (nmi)	33-34	N	Yes	0	1
Perpendicular distance to 10ths	35	N	Yes	0	9
Determined how	36	N	Yes	2	2
LATD	37-38	N	No	2	2
LATM	39-40	N	No	1	59
N or S (Hemisphere)	41	N	No	1	1
LONGD	42-44	N	No	117	121
LONGM	45-46	N	No	1	59
E or W (Hemisphere)	47	N	No	2	2
E1 obs code	48-49	N	No	6	13
E1 best est	50-53	N	Yes	1	25
E1 highest est	54-57	N	Yes	1	25
E1 lowest est	58-61	N	Yes	1	25
SP1 percent tot	62-64	N	No	50	100
SP1 code	65-66	N	No	18	99

A = ALPHA B = BLANK C = COMMA N = NUMERIC

1982 AERIAL SIGHTING FORM
Data Element Blankness and Range Editing Specifications
Record 2 of 3

NO DATA WAS COLLECTED ON THE RECORD 2 OF 3

1982 AERIAL SIGHTING FORM
Data Element Blankness and Range Editing Specifications
Record 3 of 3

Data Element	Columns	Character type	Blankness OK?	Range Lower	Range Upper
Sighting number	1- 3	N	No	1	59
Cetaceans (Y/N)	19	N	No	1	2
Birds (Y/N)	20	N	No	1	2
Fish (Y/N)	21	N	No	2	2
Good bad ugly	54	N	No	1	2

A = ALPHA B = BLANK C = COMMA N = NUMERIC

Appendix IV. The logical error criteria used to edit the 1982 aerial survey data.

FOR ASEDIT82EL

ERROR001 IF THE REASON FOR THE POSITION IS TO DIVERT (1.54=3) ... THEN THE PLANE MUST NOT BE SEARCHING-(1.55) MUST BE EQUAL TO 2.

ERROR002 IF THE REASON FOR THE POSITION IS RETURN TO TRACK (1.54=5) THEN THE PLANE MUST BE SEARCHING...(1.55) MUST BE EQUAL TO 1.

ERROR004 IF THE REASON FOR THE POSITION IS BEGIN LEG (1.54=1), THEN THE PLANE MUST BE SEARCHING... (1.55) MUST BE EQUAL TO 1.

ERROR005 IF THE REASON FOR THE POSITION IS TRACK CHECK (1.54=2), THEN THE PLANE SHOULD BE SEARCHING ... (1.55) MUST BE EQUAL TO 1.

ERROR006 THE VERTICAL SUN POSITION (1.33) MUST NOT BE EQUAL TO ANY VALUE 04 THRU 11.

ERROR022 IF THE CURRENT SIGHTING # (1.56) IS NON BLANK ...THEN THE CURRENT SIGHTING # MUST BE EQUAL TO THE LAST NON BLANK SIGHTING # PLUS 1.

ERROR023 IF THE CURRENT SIGHTING # (1.56) IS NON BLANK ...THEN THE CURRENT REASON FOR POSITION(1.54) SHOULD NOT GENERALLY BE EQUAL TO 1, 5, OR 6.

FOR ASEDIT82SL

ERROR101 THE VERTICAL SUN POSITION (1.25) MUST NOT BE EQUAL TO ANY VALUE 04 THRU 11.

ERROR132 THE SIGHTING SHOULD NOT HAVE BEEN MADE BY THE RECORDER THEREFORE SIGHT BY WHOM (1.31) MUST NOT EQUAL RECORDER (1.21).

ERROR133 IF E1 OBS CODE (1.48) IS >0...THEN E1 BEST EST (1.50) OR E1 HIGHEST EST (1.54) OR E1 LOWEST EST (1.58) MUST BE GREATER THAN ZERO.

ERROR134 IF E2 OBS CODE (2.05) IS >0...THEN E2 BEST EST (2.07) OR E2 HIGHEST EST (2.11) OR E2 LOWEST EST (2.15) MUST BE GREATER THAN ZERO.

ERROR135 IF E3 OBS CODE (2.24) IS >0...THEN E3 BEST EST (2.30) OR E3 HIGHEST EST (2.26) OR E3 LOWEST EST (2.34) MUST BE GREATER THAN ZERO.

ERROR136 IF E4 OBS CODE (2.43) IS >0...THEN E4 BEST EST (2.49) OR E4 HIGHEST EST (2.45) OR E4 LOWEST EST (2.53) MUST BE GREATER THAN ZERO.

ERROR137 IF E5 OBS CODE (2.62) IS >0...THEN E5 BEST EST (2.68) OR E5 HIGHEST EST (2.64) OR E5 LOWEST EST (2.72) MUST BE GREATER THAN ZERO.

ERROR138 IF E6 OBS CODE (3.05) IS >0...THEN E6 BEST EST (3.11) OR E6 HIGHEST EST (3.07) OR E6 LOWEST EST (3.15) MUST BE GREATER THAN ZERO.

ERROR139 IF E1 BEST EST (1.50) OR E1 HIGHEST EST (1.54) OR E1 LOWEST EST (1.58) IS >0... THEN E1 OBS CODE (1.48) MUST BE GREATER THAN ZERO.

ERROR140 IF E2 BEST EST (2.07) OR E2 HIGHEST EST (2.11) OR E2 LOWEST EST (2.15) IS >0... THEN E2 OBS CODE (2.05) MUST BE GREATER THAN ZERO.

ERROR141 IF E3 BEST EST (2.30) OR E3 HIGHEST EST (2.26) OR

```
           E3 LOWEST EST (2.34) IS >0... THEN E3 OBS CODE (2.24)
           MUST BE GREATER THAN ZERO.
ERROR142   IF E4 BEST EST (2.49) OR E4 HIGHEST EST (2.45) OR
           E4 LOWEST EST (2.53) IS >0... THEN E4 OBS CODE (2.43)
           MUST BE GREATER THAN ZERO.
ERROR143   IF E5 BEST EST (2.68) OR E5 HIGHEST EST (2.64) OR
           E5 LOWEST EST (2.72) IS >0... THEN E5 OBS CODE (2.62)
           MUST BE GREATER THAN ZERO.
ERROR144   IF E6 BEST EST (3.11) OR E6 HIGHEST EST (3.07) OR
           E6 LOWEST EST (3.15) IS >0... THEN E6 OBS CODE (3.05)
           MUST BE GREATER THAN ZERO.
ERROR145   IF E1 BEST EST AND E1 HIGHEST EST ARE NON-BLANK...THEN
              E1 BEST EST (1.50) MUST BE <= E1 HIGHEST EST (1.54)
ERROR146   IF E1 BEST EST AND E1 LOWEST EST ARE NON-BLANK ...THEN
              E1 BEST EST (1.50) MUST BE => E1 LOWEST EST (1.58).

                                FOR ASEDIT82SL

ERROR147   IF E1 LOWEST EST AND E1 HIGHEST EST ARE NON-BLANK ...
           THEN E1 LOWEST EST (1.58) MUST BE <= E1 HIGHEST_EST
           (1.54).
ERROR148   IF E2 BEST EST AND E2 HIGHEST EST ARE NON-BLANK...THEN
              E2 BEST EST (2.0 ) MUST BE <= E2 HIGHEST ESO (2.11)
ERROR149   IF E2 BEST EST AND E2 LOWEST EST ARE NON-BLANK ...THEN
              E2 BEST EST (2.07) MUST BE => E2 LOWEST EST (2.15).
ERROR150   IF E2 LOWEST EST AND E2 HIGHEST EST ARE NON-BLANK ...
           THEN E2 LOWEST EST (2.15) MUST BE <= E2 HIGHEST EST
           (2.11).
ERROR151   IF E3 BEST EST AND E3 HIGHEST EST ARE NON-BLANK...THEN
              E3 BEST EST (2.26) MUST BE <= E3 HIGHEST EST (2.30)
ERROR152   IF E3 BEST EST AND E3 LOWEST EST ARE NON-BLANK ...THEN
              E3 BEST EST (2.26) MUST BE => E3 LOWEST EST (2.34).
ERROR153   IF E3 LOWEST EST AND E3 HIGHEST EST ARE NON-BLANK ...
           THEN E3 LOWEST EST (2.34) MUST BE <= E3 HIGHEST EST
           (2.30).
ERROR154   IF E4 BEST EST AND E4 HIGHEST EST ARE NON-BLANK...THEN
              E4 BEST EST (2.45) MUST BE <= E4 HIGHEST EST (2.49)
ERROR155   IF E4 BEST EST AND E4 LOWEST EST ARE NON-BLANK ...THEN
              E4 BEST EST (2.45) MUST BE => E4 LOWEST EST (2.53).
ERROR156   IF E4 LOWEST EST AND E4 HIGHEST EST ARE NON-BLANK ...
           THEN E4 LOWEST EST (2.53) MUST BE <= E4 HIGHEST EST
           (2.49).
ERROR157   IF E5 BEST EST AND E5 HIGHEST EST ARE NON-BLANK...THEN
              E5 BEST EST (2.64) MUST BE <= E5 HIGHEST EST (2.68)
ERROR158   IF E5 BEST EST AND E5 LOWEST EST ARE NON-BLANK ...THEN
              E5 BEST EST (2.64) MUST BE => E5 LOWEST EST (2.72).
ERROR159   IF E5 LOWEST EST AND E5 HIGHEST EST ARE NON-BLANK ...
           THEN E5 LOWEST EST (2.72) MUST BE <= E5 HIGHEST EST
           (2.68).
ERROR160   IF E6 BEST EST AND E6 HIGHEST EST ARE NON-BLANK...THEN
              E6 BEST EST (3.07) MUST BE <= E6 HIGHEST EST (3.11)
ERROR161   IF E6 BEST EST AND E6 LOWEST EST ARE NON-BLANK ...THEN
              E6 BEST EST (3.07) MUST BE => E6 LOWEST EST (3.15).
ERROR162   IF E6 LOWEST EST AND E6 HIGHEST EST ARE NON-BLANK ...
           THEN E6 LOWEST EST (3.15) MUST BE <= E6 HIGHEST EST
```

(3.11).

ERROR163 IF % SPECIES 1 (1.62) >0, THEN SPECIES CODE 1 (1.65) MUST BE >0.

ERROR164 IF % SPECIES 2 (2.19) >0, THEN SPECIES CODE 2 (2.22) MUST BE >0.

ERROR165 IF % SPECIES 3 (2.38) >0, THEN SPECIES CODE 3 (2.41) MUST BE >0.

FOR ASEDIT82SL

ERROR166 IF % SPECIES 4 (2.57) >0, THEN SPECIES CODE 4 (2.60) MUST BE >0.

ERROR167 IF % SPECIES 5 (2.76) >0, THEN SPECIES CODE 5 (2.79) MUST BE >0.

ERROR168 IF SPECIES CODE 1 (1.65) >0, THEN % SPECIES 1 (1.62) MUST BE >0.

ERROR169 IF SPECIES CODE 2 (2.22) >0, THEN % SPECIES 2 (2.19) MUST BE >0.

ERROR170 IF SPECIES CODE 3 (2.41) >0, THEN % SPECIES 3 (2.38) MUST BE >0.

ERROR171 IF SPECIES CODE 4 (2.60) >0, THEN % SPECIES 4 (2.57) MUST BE >0.

ERROR172 IF SPECIES CODE 5 (2.79) >0, THEN % SPECIES 5 (2.76) MUST BE >0.

ERROR173 IF ANY OF THE FOLLOWING ARE NON-BLANK ... THEN THE SUM OF ALL OF THEM MUST BE EQUAL TO 100.
% SPECIES 1 (1.62)
% SPECIES 2 (2.19)
% SPECIES 3 (2.38)
% SPECIES 4 (2.57)
% SPECIES 5 (3.76)

ERROR174 AT LEAST ONE OF THE FOLLOWING MUST BE >0
% SPECIES 1 (1.62)
% SPECIES 2 (2.19)
% SPECIES 3 (2.38)
% SPECIES 4 (2.57)
% SPECIES 5 (3.76)

ERROR187 IF ANY OF THE FOLLOWING FIELDS ARE BLANK : BOW OBSERVER (S)(1.15), RECORDER (S)(1.21), OR SIGHTER (S)(1.31) ... THIS CONSTITUTES AN ERROR .

ERROR188 IF THE BOW OBSERVER (S)(1.15) IS '06' ... SIGHTER (1.31) MUST BE EQUAL TO ONE OF THE FOLLOWING '06' , '12' , OR '13' .

ERROR189 IF THE BOW OBSERVER (S)(1.15) IS '12' ... SIGHTER (1.31) MUST BE EQUAL TO ONE OF THE FOLLOWING '12' , '13' , '06' .

ERROR190 IF THE BOW OBSERVER (S)(1.15) IS '13' ... SIGHTER (1.31) MUST BE EQUAL TO ONE OF THE FOLLOWING '13' , '12' , OR '06' .

ERROR194 THE ELEMENT PLANE IN SEARCH ? Y/N (S)(3.54) IS EQUAL TO '2' ... THIS MAY CONSTITUTE AN ERROR .

FOR ASEDIT82XL

ERROR213 IF THE BOW OBSERVER (S)(1.15) IS '06' ... BOW OBSERVER (E)(1.21) ON THE CURRENT EFFORT RECORD MUST BE '06' .

ERROR214 IF THE BOW OBSERVER (S)(1.15) IS '12' ... BOW OBSERVER (E)(1.21) ON THE CURRENT EFFORT RECORD MUST BE '12' .

ERROR215 IF THE BOW OBSERVER (S)(1.15) IS '13' ... BOW OBSERVER (E)(1.21) ON THE CURRENT EFFORT RECORD MUST BE '13' .

FOR ASEDIT82YL

ERROR301 IF THE CURRENT FLIGHT #(1.04) IS EQUAL TO THE PREVIOUS FLIGHT #(1.04)...THE CURRENT LEG #(1.06) MUST BE EQUAL TO THE PREVIOUS LEG# +1 OR THE PREVIOUS LEG# +1

ERROR302 IF THE CURRENT FLIGHT #(1.04) IS EQUAL TO THE PREVIOUS FLIGHT #(1.04)...THE CURRENT DATE (1.08) MUST BE EQUAL TO THE PREVIOUS DATE.

ERROR303 IF THE CURRENT FLIGHT #(1.04) IS EQUAL TO THE PREVIOUS FLIGHT #(1.04)...THE CURRENT TIME (1.49-1.53) MUST BE GREATER THAN THE PREVIOUS TIME.

ERROR306 IF THE CURRENT FLIGHT #(1.04) IS EQUAL TO THE PREVIOUS FLIGHT #(1.04)...THE CURRENT LAT DEG(1.36-1.40) MUST BE WITHIN 1 DEG OF THE PREVIOUS LAT DEG.

ERROR307 IF THE CURRENT FLIGHT #(1.04) IS EQUAL TO THE PREVIOUS FLIGHT #(1.04)...THE CURRENT LONG DEG(1.42-1.47) MUST BE WITHIN 1 DEG OF THE PREVIOUS LONG DEG.

ERROR308 IF THE CURRENT FLIGHT #(1.04) IS EQUAL TO THE PREVIOUS FLIGHT #(1.04) AND THE CURRENT REASON FOR POSITION (1.54) IS EQUAL TO 1, 3, 5, OR 6,... THEN THE PREVIOUS REASON FOR POSITION MUST NOT EQUAL THE CURRENT REASON FOR POSITION.

ERROR309 IF THE CURRENT FLIGHT #(1.04) IS EQUAL TO THE PREVIOUS FLIGHT #(1.04) AND THE PREVIOUS REASON FOR POSITION (1.54) EQUALS 3 ... THEN THE CURRENT REASON FOR POSITION MUST EQUAL 4 OR 5.

ERROR310 IF THE CURRENT FLIGHT #(1.04) IS EQUAL TO THE PREVIOUS FLIGHT #(1.04) AND THE PREVIOUS REASON FOR POSITION (1.54) EQUALS 3 AND THE CURRENT REASON FOR POSITION IS 4... THEN THE PLANE MUST NOT BE SEARCHING ... (1.55) MUST EQUAL 2.

ERROR317 THE ELEMENT REASON POSITION (1.54) ON THE CURRENT RECORD IS EQUAL TO '1' ... AND NONE OF THE FOLLOWING ELEMENTS ON THE CURRENT RECORD ARE DIFFERENT FROM CORRESPONDING ELEMENTS ON THE PREVIOUS RECORD : DATE (1.08), ALTITUDE (1.14), GROUND SPEED (1.18), BOW OBSERVER CODE (1.21), RECORDER CODE (1.29), HORIZONTAL SUN (1.31), VERTICAL SUN (1.33), OR BEAUFORT (1.35), THIS IS AN ERROR .

Appendix V. The dBASE III Plus structure used to archive the 1982 aerial survey data for TRANSECTS and SIGHTINGS.

1982 AERIAL SURVEY TRANSECT

Structure for database: C:AE82.DBF
Number of data records: 227
Date of last update : 04/04/88

Field	Field Name	Type	Width	Dec
1	BLANK1	Character	3	
2	FLIGHT	Numeric	2	
3	LEG	Numeric	2	
4	YEAR	Numeric	2	
5	MONTH	Numeric	2	
6	DAY	Numeric	2	
7	ALTITUDE	Numeric	4	
8	GROUNDSPEE	Numeric	3	
9	BOW_OBS_CD	Numeric	2	
10	BLANK2	Character	2	
11	LFT_OBS_CD	Numeric	2	
12	RIT_OBS_CD	Numeric	2	
13	RECORDER	Numeric	2	
14	HORIZ_SUN	Numeric	2	
15	VERT_SUN	Numeric	2	
16	BEAUFORT	Numeric	1	
17	LATD	Numeric	2	
18	LATM	Numeric	4	1
19	N_OR_S	Numeric	1	
20	LONGD	Numeric	3	
21	LONGM	Numeric	4	1
22	E_OR_W	Numeric	1	
23	HOUR	Numeric	2	
24	MINUTE	Numeric	4	1
25	REASON_POS	Numeric	1	
26	SEARCHING	Numeric	1	
27	BLANK3	Character	1	
28	SIGHT_NO	Numeric	4	1
29	DISTANCE	Numeric	6	2
** Total **			70	

Structure for database: C:AS82.DBF
Number of data records: 60
Date of last update : 03/24/88

Field	Field Name	Type	Width	Dec
1	SIGHT_NO	Numeric	4	1
2	FLIGHT	Numeric	2	
3	LEG	Numeric	2	
4	YEAR	Numeric	2	
5	MONTH	Numeric	2	
6	DAY	Numeric	2	
7	BOW_OBS_CD	Numeric	2	
8	LFT_OBS_CD	Numeric	2	
9	RIT_OBS_CD	Numeric	2	
10	RECORDER	Numeric	2	
11	HORIZ_SUN	Numeric	2	
12	VERT_SUN	Numeric	2	
13	TEMP	Character	3	
14	BEAUFORT	Numeric	1	
15	SIGHTER	Numeric	2	
16	P_DIST	Numeric	4	1
17	DIST_HOW	Character	1	
18	LATD	Numeric	2	
19	LATM	Numeric	2	
20	N_OR_S	Numeric	1	
21	LONGD	Numeric	3	
22	LONGM	Numeric	2	
23	E_OR_W	Numeric	1	
24	OBS_CD	Numeric	2	
25	BEST_EST	Numeric	4	
26	HIGH_EST	Numeric	4	
27	LOW_EST	Numeric	4	
28	SP_PERCENT	Numeric	3	
29	SP_CODE	Numeric	2	
30	PORPOISE	Character	1	
31	BIRDS	Character	1	
32	FISH	Character	1	
33	SEARCHING	Numeric	1	
34	L_R_C	Character	1	
35	GMT_TIME	Numeric	6	1
** Total **			79	